

FERMILAB

RESEARCH DIVISION / MECHANICAL DEPARTMENT - MS#221
WILSON HALL 13TH FLOOR - PHONE: (708) 840-4710 FAX : 840-2950

February 14, 1992

TO: HERM STREDDE & Mechanical Safety Review Panel
FROM: DONALD V. MITCHELL DVM
SUBJECT: CMEX Movement Procedure Review for Approval

Enclosed you will find 2 copies of the CMEX Movement Procedure. Section 2.3 has been added and reviewed by John Grimson and is now being sent to you for your review and approval.

These 2 copies are the "Control Copies" that will be maintained at CDF on permanent record. If you and your committee approve this version of the movement procedure, then please sign these copies and forward them to Peter Garbincius for his approval. He can then forward these copies to Bob Kephart and John Cooper at the CDF Department office.

If there are revisions that still need to be made, then please contact me as soon as possible so that I can expedite the needed changes.

THANK YOU!

encl
2, CMEX Movement Plan

CDF-403
9:49 AM

"CMEX Movement From Assembly Hall
to Collision Hall and Back"

2/14/92

CONTROL COPY

CMEX Movement From Assembly Hall to Collision Hall and Back

(this is a mechanical Installation Procedure)

This procedure outlines the steps to be used to safely move a CMEX conical frame in the assembly hall, through the transfer hall, and into position in the collision hall.

Due to the weight and cost of a CMEX conical frame, it is required that the head of the Research Division review and approve this moving procedure.

Approvals:

Herman J. Studd
(Safety Committee Head)

FEB 19, 1992
(Date)

(CDF Department Head)

(Date)

(Research Division Head)

(Date)

CDF-403
11:21 AM

"CMEX Movement From Assembly Hall
to Collision Hall and Back"

2/20/92

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1.0 Controlled Copies of this Procedure.

Two controlled copies of this procedure will exist.

One will be held in the CDF Department office.

One will be held in the CDF front office.

All other copies will be marked, **"INFORMATIONAL COPY ONLY"**.

2.0 CDF Movement Procedures

STEP 1: Identify Key Personnel and their Responsibilities

2.0.1: Objective: To identify the responsibilities of each individual involved in the movement of a CMEX frame.

2.0.2: Responsibilities:

a). **Building Manager:** will oversee the movement operation from a distance great enough to easily see all personnel and equipment involved in the move and to watch for over-head obstructions. He will report any developing or potential problems to the foreman. At no time will the building manager take over for the foreman. The building manager is there to assist and insure that overall safety is being maintained.

b). **Responsible Engineer:** may be called on to function as the building manager. May also be called upon to solve structural/mechanical problems such as: how to move obstacles, or how to cross gaps in the floor. He will be a structural or mechanical engineer designated by CDF.

c). **Foreman:** will insure that all personnel under his directive have performed their maintenance checks of the equipment and will insure that the equipment is installed properly. He will make certain that his personnel are located in their designated areas before the move begins (to include the building manager or the responsible engineer). He will specify who will operate the equipment such as: the forklift, or the unified hydraulic lifts. He will move freely in the work area to insure that the movement of the frame is slow (less than .5 ft/s) and completely controlled. His directives will be followed completely and therefore he becomes responsible for the safety of the personnel and equipment involved during the move. **NO** movement of the frame will be conducted without his presence.

d). **Ironworkers:** will install all equipment and will insure that the equipment is serviceable and free from defects. They will keep the area clean and free from obstructions and will follow all directives from the foreman.

e). **Forklift Operator:** will be designated by the foreman and will be qualified to operate the equipment used to push/pull the CMEX frame. He will insure that his equipment is serviceable by conducting Preventive

Maintenance, Checks and Services. He will also check to make sure that all slings, chains, or cables attached between the forklift and frame are connected properly. He will follow all directives from the foreman.

2.1 Across The Floor Preliminary Operating Procedures

The following procedures for moving a CMEX frame across the floor will be followed with the strictest adherence to each step and will be verified by the crew foreman.

STEP 2: Area Preparation:

WARNING!

Operating the overhead crane in the vicinity of a CMEX frame could cause damage to the frame or could cause the frame to topple.

CAUTION!

Rolling a CMEX frame over loose debris could cause the Hilman rollers to bind or stop suddenly. This could cause damage to the CMEX frame or could affect the alignment of the CMEX chambers.

2.1.1: Objective: To provide a safe working environment for the safety of the personnel as well as the CMEX frame.

2.1.2: Procedure: The area in which the CMEX frame will be moved will have all obstacles moved clear of the area and will have the floor completely swept of debris. During the move, the ironworkers will continuously verify that no objects are lying in the movement area. All over-head obstacles will be cleared from the area. Crane operations in the vicinity of the move, non-related to the CMEX move, will not be permitted during the movement of a CMEX frame.

STEP 3: Key Equipment/Inspection of Equipment:

2.1.3: Objective: To maintain proper performance of equipment for serviceability and safety.

2.1.4: Equipment:

a). Forklift: will be inspected before each use for hydraulic leaks, proper braking and steering function, and adequate power supply.

b). Slings/chains: will be free from excessive wear; such as tears, shreds, or irregular deformation.

c). Hilman Rollers: will be free from defects, will roll easily, and will utilize a friction pad/spacer (fiberboard or plywood). The rollers will have four bolts to attach the turntable to the rollers to insure that the roller does not roll out from under the frame.

d). Hydraulic Jacks/Unified Hydraulic Jacks: will be inspected for leaks, cracks or other defects. The top and bottom surfaces will be cleared of all debris. The foreman will designate who is qualified to check this equipment.

STEP 4: Placement of Equipment/Personnel

WARNING! A large upward force could cause the CMEX frame to topple.

NOTE: While conducting the move, all directives will be given **ONLY** by the foreman.

a). Slings, chains, or cables may be connected from the forklift to the base of the CMEX frame as long as the attachment angle is within a $+ -10^{\circ}$ deviation from horizontal. The forklift will be no further than 10 ft from the CMEX frame when pulling.

b). The forklift may also be used to push the CMEX frame. When pushing, the forks will reside completely under the CMEX frame base plate. At no time will the forklift attempt to pick up the CMEX frame.

c). The Forklift Operator should always be in eye or voice contact with the foreman.

d). The Ironworkers will be positioned so that they can identify problems with the frame, slings, chains, cables, or Hilman Rollers. They will be located at the corners of the frame base and will have, on-hand, roller stops such as a wooden wedge to stop the frame from rolling in an emergency situation.

e). Restraint chains, slings, or come-a-longs will be secured to the frame and will act in the opposite direction of the pull or push to help control the speed of the move or to assist in stopping. This method is to be used only when the ironworkers cannot be in appropriate positions to control the move themselves.

f). The foreman is free to move around the work area to supervise and give instructions.

g). The Building Manager will stay at such a distance to allow himself a clear view of all workers and the entire frame. Overall safety is his key concern. He may be located on the balcony if this location provides the best view. To avoid confusion among the workers, the Building Manager communicates to the foreman only.

2.2 Across The Floor Operating Procedures

2.2.1: Objective: To reposition a CMEX frame in a slow, controlled manner so that safety to personnel and equipment is maintained.

STEP 5: Starting/Stopping the move:

CAUTION! A quick start or stop can cause damage to the alignment of the muon chambers.

WARNING! A very fast start/stop or impact into another object could cause failure in the CMEX frame which could result in extensive damage or personal injury.

2.2.2: A controlled, very slow move of the CMEX frame is critical for maintaining accuracy in the location of the Muon Chambers and more importantly, the safety of the workers. Calculations, to include safety factors, have shown that the CMEX frame can be moved at a maximum speed of .5 ft/s. However, the frame cannot withstand a sudden impact (dead stop) at this speed and therefore should be slowed down to almost a complete stop before being pushed up against a stop.

2.2.3: Sudden jerks should be avoided when starting or stopping. Slings may be utilized to yield some give in the system for a smoother start and stop.

STEP 6: Adjusting the rollers to make a turn:

WARNING! Cribbing must be used for even the slightest lifts. Without cribbing, a failure in a hydraulic jack could result in a massive shift in weight which could cause the frame to topple.

WARNING! Hands and fingers should never be placed between the Hilman supports and the Hilman rollers. Loss of extremities could result.

CAUTION! Turning the frame must be conducted with great care. The .5 ft/s speed limitation is not valid for turns. Turns must be conducted as slow as possible. If need be, come-a-longs could be utilized.

2.2.4: Turns should be made very slowly. The Hilman Rollers may need slight adjusting when making turns.

2.2.5: Realigning Hilman Rollers:

a). To realign the Hilman Rollers, hydraulic jacks or screw jacks must be used to slightly raise the frame. A corner of the frame may be raised alone if it is not raised more than 1/2". With the frame raised, cribbing will be inserted to prevent a sudden drop if hydraulic pressure is lost. The rollers can then be adjusted and once again a locator bolt will be put into place. With the roller in a new alignment configuration, the cribbing can be removed and the frame can then be hydraulically or mechanically lowered back to the floor. The same process can then be used on the other corners.

b). Realignment can also be achieved by utilizing a "unified hydraulic lifting system." Four hydraulic jacks must be placed at each corner of the CMEX frame. The jacks are raised at the same time to a height not to exceed 1". Cribbing is put in place to prevent against a sudden drop. The rollers are repositioned, the cribbing removed, and the frame lowered back onto the Hilman rollers. A hydraulic Jack operator must be designated by the foreman.

2.3: Change in Elevation Operations

NOTE: Step 2 will be in effect during any portion of a CMEX move.

STEP 7: Key Equipment/Inspection of Equipment

2.3.1: Objective: To maintain proper performance of equipment for serviceability and safety.

2.3.2: Equipment:

NOTE: Equipment mentioned in STEP 3 will not be repeated here.

a). Transport Table: will be inspected for proper installation of Hilman Roller supports and hook lifting plates; to include the checking of all bolts for proper torque. Hilman Roller supports will be torqued to 180 ft-lbs. Permanently mounted lifting plates will be torqued to 250 ft-lbs.

b). Lifting Hooks: will be visually inspected for stress cracks. They will not be lifted by hand. A lifting eye and forklift/crane will be utilized for "Lifting Hook" positioning.

c). Bridge Steel: will be inspected for unusual deformations.

STEP 8: Placement of Equipment/Personnel

WARNING! While the table is being lifted with jacks, a large, horizontal force could cause the table to topple.

NOTE: While conducting the lift, all directives will be given only by the foreman.

2.3.3: Objective: to identify the location of key personnel and equipment during a change in elevation operation.

a). A Hilman support and roller will be bolted onto the table on each of the four corners. The bolts will be torqued to 180 ft-lbs. A 1/2" fiberboard, plywood, or rubber spacer will be placed between the support and the roller. At a minimum, 2 bolts will be used to secure the roller to the support. Section 2.2.5 will be used for placement of the Hilman Rollers.

b). Four lifting hooks will be placed at each of the four corners. They will be lifted into position utilizing a sling and a forklift/crane. The sling will be attached to a lifting eye located on top of each lifting hook. The prongs on each hook will be seated snugly against the bottom edge of each corresponding lifting plate. Once in position, four 1" Dia. bolts will be used to secure each hook against the lifting plate. These bolts will be torqued to 180 ft-lbs.

c). Four 50 ton hydraulic jacks will be bolted to a corresponding jackstand and placed under each lifting hook. The jack will be pushed completely under the hook until it meets resistance. Lifting eyes (2) on each jackstand will be used in conjunction with slings and a forklift/crane for positioning.

d). The unified hydraulic lifting apparatus will be connected to each hydraulic jack. The hose connections will be inspected by the foreman or the chief operator (appointed by the foreman).

e). A forklift will be used to roll the transport table into position against a 4' wall. When pushing, the forks will reside completely under the table. At no time will the forklift attempt to lift the transport table.

f). The forklift operator will always be in eye or voice contact with the foreman.

g). The ironworkers will be positioned one at each corner of the table. They will inspect for stability of the cribbing and will be responsible for the cribbing of the table at their corner. The foreman will verify that the cribbing has been positioned properly.

h). Refer to STEP 4 for the placement of the foreman and building manager.

STEP 9: Raising the Transport Table

NOTE: At no time will there be a gap larger than 4" between the table and cribbing.

NOTE: Only a qualified "unified lifting system" operator may operate the lifting system. The foreman will designate this operator.

2.3.4: Objective: To safely raise a CMEX frame from the 706 elevation to the 710 elevation using a unified hydraulic jack system and wood cribbing.

2.3.5: Lifting Procedures:

a). The foreman will inspect the hydraulic lifting system for proper installation. He will verify that all equipment and personnel are in place before the lift begins.

- b). By following the manufacture's procedures, activate the jacks and begin lifting the table.
- c). As the table rises to the first 12" height, crib the table with 4x4 timbers.
- d). Re-position the jacks for the next 12" rise. The foreman will confirm that the jacks are re-positioned accurately. Raise and crib the table again for the second 12" rise.
- e). Repeat "d" again until the table is flush with the 710 elevation.
- f). Secure the table to the wall with 2, 1/2" connection plates bolted between the table and the wall. These plates will keep the table from moving away from the wall when a CMEX frame is pushed onto the table.
- g). Position 1"x6" bridge steel in the gap between the table and the wall. This is used to produce a smooth transition between the wall and the table.

STEP 10: Moving a CMEX Frame onto the Transport Table

NOTE: A 9 chamber frame must stay on the far west side of the transport table to avoid hitting the cable beams mounted on the ceiling.

2.3.6: Objective: To safely and slowly move a CMEX Frame onto the transport table for lowering down to the 706 elevation.

2.3.7: Rolling Procedures:

- a). The transport table will be swept clean of all debris.
- b). The foreman will verify that the cribbing is properly installed and that the 1/2" thick connection plates between the wall and the table are attached.
- c). Using a forklift and pre-defined pushing/pulling procedures, a CMEX frame will be moved onto the transport table.
- d). Hydraulic or manual jacks will be used to slightly raise the CMEX frame above the transport table. The Hilman rollers on the CMEX frame will be removed and replaced with wood cribbing. The CMEX frame will then be

lowered down onto the cribbing. This procedure is necessary to stabilize the CMEX frame on top of the transport table while the table is being moved. The reverse of this procedure will be used to prepare the CMEX frame for dismounting the transport table.

STEP 11: Lowering the Transport Table

NOTE: At no time will there be a gap larger than 1" between the table and the cribbing.

2.3.8: Objective: A cautious, slow lowering of a CMEX Frame will be conducted to maximize safety to personnel and equipment.

2.3.9: Lowering Procedures:

- a). In general, STEP 9 will be followed in reverse order.
- b). Sudden stops must be avoided to prevent damage to the chamber gas seals.
- c). Hilman Rollers should be positioned using 2.2.5 before the table is placed onto the floor.

STEP 12: Rolling Procedures

2.3.10: Objective: To obtain a slow, cautious move with minimum stress to the frame.

2.3.11: Rolling Procedures:

- a). Hydraulic jacks, hoses, and jackstands will be removed from under the transport table.
- b). 1" thick steel plates will be placed on the 706 elevation to provide a smooth, load distributing surface for the Hilmans to roll across.
- c). The area will be swept clean of all debris.
- d). STEP 4 will be utilized for moving the transport table into or out of the CDF Collision Hall.

3.0 Required Training and Authorized Training Personnel

3.0.1: To operate the Forklift: the operator is expected to know how to conduct Preventive Maintenance, Checks, and Services and how to operate all functions of the forklift; including emergency operations. He will demonstrate his ability to the foreman before being designated as the Forklift Operator.

3.0.2: To operate the Unified Hydraulic Jacks: the operator is expected to know how to identify problems in the operating system (such as leaks or damaged parts), how to implement the system, how to properly crib a structure, how to make multiple lifts utilizing cribbing, and how to handle failures. He will demonstrate his ability to the foreman before being designated as a Unified Hydraulic Jack Operator.

3.0.3: To realign Hilman rollers: the operator must demonstrate his ability to operate an individual hydraulic jack (using standards from 3.0.2) and must demonstrate, to the instructor, his awareness of safety related issues involving hand placement on the rollers.

LIST OF AUTHORIZED INSTRUCTORS FOR THESE PROCEDURES

Name John Grimson and Bob Shovan will implement procedures for training.
Last, First

Name _____ ID # _____
Last, First

Name _____ ID # _____
Last, First

Name _____ ID # _____
Last, First

Name _____ ID # _____
Last, First

Name _____ ID # _____
Last, First

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4.0 Training

Manual on Forklift operations.

Manual on Unified Hydraulic Lifting System.

Outside contracted help will provide their own qualified personnel.

There are no other special training materials for this procedure.

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5.0 List of Trained People for this procedure

The most current copy of this training list must be kept with the controlled copy of this movement procedure. The controlled copy is maintained in the CDF Department office. If the trained individual's name is not on the controlled copy list, then that individual is NOT authorized to operate the specified equipment.

This list does not need to be approved by the Research Division Head or by the head of CDF.

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5.1 Forklift Operators:

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

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5.1 Unified Hydraulic Lift Operators:

name, ID # date expires

signature: approved by:

name, ID # date expires

signature: approved by:

name, ID # date expires

signature: approved by:

name, ID # date expires

signature: approved by:

name, ID # date expires

signature: approved by:

name, ID # date expires

signature: approved by:

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5.1 Hilman Roller Adjustment Operators:

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

name, ID #	date	expires
signature: _____	approved by: _____	

6.0 Checklist

- 1). Key personnel assigned to perform movement of CMEX frame
(authorized instructor/foreman has approved personnel)
- 2). Floors swept clear of debris
- 3). Area cleared of obstacles
- 4). Equipment has been checked for serviceability
- 5). Personnel and equipment are positioned in their assigned locations
- 6). Move is conducted (controlled by foreman)
- 7). Frame is secured in new location
- 8). equipment is cleaned and put away

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7.0 Deviations From This Procedure

None at this time.

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8.0 References and Supporting Documentation

None at this time.

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RESEARCH DIVISION / MECHANICAL DEPARTMENT - MS#221

WILSON HALL 13TH FLOOR - PHONE: (708) 840-4710 FAX : 840-2950

January 31, 1992

TO: See Distribution

FROM: DONALD V. MITCHELL *DM*

SUBJECT: CMEX TRANSPORT TABLE

Enclosed you will find a copy of the CMEX Transport Table calculations and an assembly layout drawing of the table. As previously discussed, this table should be reviewed for proper safety.

This packet, hopefully, is self-explanatory. However, if you have any questions feel free to call. We can also set up a meeting if necessary.

A load test for the transport table is being planned for sometime within the next two weeks. I will notify you of the testing date.

* Revisions to the CMEX movement procedure are being made and will be re-distributed soon. Also, the additional movement plan covering the use of the CMEX Transport Table will be included.

Distribution:

Herm Stredde
John Grimson
Rich Luther
Ang Lee
Fritz Lange

January 10, 1992

To: Peter Garbincius, Head Research Division
Steve Holmes, Head Accelerator Division

From: Herman J. Sredde, Chairman CDF Safety Panel

Subject: Movement Of CMEX Frames

Don Mitchell, Research Div. Engineer, has developed the Operating Procedure for moving the CMEX frames with all nine chambers in place. This procedure has been reviewed by the safety panel. The panel made suggestions which have been incorporated into the procedure.

It is noted here that the procedure as written covers only motions in the same plane, i.e. no vertical motion is discussed. It will be necessary at a later date to revise this procedure to account for the vertical motions required for movement into the collision hall.

The safety panel approves the procedure as written and will review the amended version when applicable.

A copy of the procedure for your review will be forwarded to your office by Tuesday, January 14.

cc

J. Grimson
H. Jensen
P. Lukins
F. Lange
A. Lee
R. Luther
R. Truett
G. Rametta
CDF-File

*Approved for Horizontal Motion
in Assembly Hall only, at this time*
Peter V. Garbincius

10 Jan 92 -

November 15, 1991

To: Peter Garbincius, Head Research Division
Stephen Holmes, Head Accelerator Division

From: H.J. Stredde, Chairman CDF Mech. Safety Panel

Subject: Installation of Seven CMEX Chambers

The Safety panel has received and reviewed the calculations pertinent to the seven chamber structure. The bolted joint analysis was treated with both shear and tensile forces, and it proved to be well within safe limits. The acceleration force has been addressed and the structure is safe for a force of .5g's or less. The maximum allowable speed during installation shall be specified in the operations procedure.

The seven chamber unit has three chambers cantilevered from the base structure. The chamber to chamber connection has been reviewed and is adequate for specified loads. The top two supports of the main support frame have additional gussets added to the structure at these points. The Gussets were added before the analysis was made and although the results of the analysis demonstrated that the gussets were not needed, we simply have additional safety in this area.

The Safety panel agrees that the structure as presented is safe and we recommend approval of this installation.

Approval for Installation of the 7 CMEX chambers only.

Peter Garbincius

15 Nov 91

cc

P. Lukins
J. Grimson
F. Lange
A Lee
R. Luther
H. Jensen
D. Mitchell

P. H. Garbincius

S. Holmes

H. Stredde

R. Kephart

CDF Panel

⇒ Distribution